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# Fatigue and Fracture Test Planning, Test Data Acquisitions and Analysis

STP 1598

Editors:  
Zhigang Wei  
Kamran Nikbin  
Peter C. McKeighan  
Gary D. Harlow



**SELECTED TECHNICAL PAPERS**  
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# Fatigue and Fracture Test Planning, Test Data Acquisitions and Analysis

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## Foreword

THIS COMPILATION OF Selected Technical Papers, STP1598, *Fatigue and Fracture Test Planning, Test Data Acquisitions and Analysis*, contains peer-reviewed papers that were presented at a symposium held May 4–5, 2016, in San Antonio, Texas, USA. The symposium was sponsored by ASTM International Committee E08 on Fatigue and Fracture and Subcommittee E08.03 on Advanced Apparatus and Techniques.

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## Overview

ASTM STP1598 contains a collection of 20 peer-reviewed papers from the Symposium on Fatigue and Fracture Test Planning, Test Data Acquisitions and Analysis held May 4–5, 2016, in San Antonio, Texas, USA. The symposium was sponsored by ASTM Committee E08 on Fatigue and Fracture in conjunction with the 2016 May standards development meetings of the Committee. The symposium was attended by a number of professionals representing several countries, including the United States, Canada, United Kingdom, Germany, Australia, Netherlands, Sweden, China, and India. The driving force behind this symposium is the revision of several relevant ASTM standards, especially ASTM E739-10 (2015), *Standard Practice for Statistical Analysis of Linear or Linearized Stress-Life (S-N) and Strain-Life ( $\epsilon$ -N) Fatigue Data*.

Understanding and preventing fatigue failure and fracture of engineering materials and structures are critical in several industries. Material testing is fundamental to gaining a better understanding of fatigue and fracture phenomena, as well as to guide materials selection, product design, and quality control. In fact, engineering design, development, and validation heavily relies on accurate test data and the proper interpretation of test data. Although a significant amount of knowledge and understanding has been gained over the last several decades via material testing, there still remains a substantial amount of improvement needed due to procedural deficiencies and limitations. The need for testing improvement is becoming more critical as materials are increasingly stretched to their limits by extreme conditions of temperature, stress, corrosive environments, and longer service life cycles. With new applications, some of the previously tested materials and procedures prove inadequate and inconsistent, demanding a collective and interdisciplinary effort to generate reliable and high-quality data. To embrace the new developments, the following areas of particular interest were selected as the main themes for the symposium: 1) test planning, 2) data acquisition and processing, and 3) data analysis and interpretation. Although many of the papers and presentations include content focused on these three topics, the symposium co-chairs were pleased to welcome other closely related topics and emerging issues in fatigue and fracture.

The major objective of the symposium was to provide a forum for engineers, managers, researchers and scholars worldwide to exchange ideas, share best practices,

discuss challenges, and identify opportunities and directions for future developments and applications. Specific objectives include:

- 1) Showcase the most current research and advances in these areas;
- 2) Promote a systematic, unified materials test plan for improved data acquisition and analysis; and
- 3) Collect information and supporting documents for updating existing fatigue, creep, and fracture test standards and identify the needs for new standards.

Two keynote lectures at the symposium were presented by Krishnaswamy Ravi-Chandar (The University of Texas at Austin) and Youshi Hong (Institute of Mechanics, Chinese Academy of Sciences), respectively, at the beginning of each day of the two-day symposium. A panel discussion on “The Challenges and Opportunities in Fatigue and Fracture Test Planning, Test Data Acquisitions, and Analysis” was held at the end of the first day of the symposium. The panel consisted of the following experts in their respective areas: Michael Shepard (MTS Systems Corporation), Steven Thompson (AFRL/RXSA), Dan Lingenfeller (HBM nCode Federal LLC), Peter McKeighan (Symmetry Engineering and Forensic Consulting LLC), and Charlotte Belsick (Lockheed Martin). Bruce Young (Battelle) served as a substitute chair in the last day of the symposium.

The papers presented in the symposium were arranged into four sessions:

Session 1: Testing Planning and Performance Characterization

Session 2: Data Acquisition, Quality Assurance, and Analysis

Session 3: Modeling/Simulation, Interpretation, and Correlation

Session 4: Verification, Validation, and Applications

The papers collected in this STP are arranged in the same order. These papers provide a diverse source of new information regarding test planning, data acquisition and analysis that can help accelerate the revision of the existing standards and the development of new standards. These papers also represent a significant contribution to ASTM E08’s commitment to expanding the knowledge base that supports design and testing as related to fatigue and fracture.

The symposium co-chairs express our sincere gratitude to ASTM staff for all their contributions to planning throughout the many months preceding the symposium and the STP1598 publication. Additionally, Dr. Markus Heinimann (Arconic) and Charlotte Belsick (Lockheed Martin) are also highly appreciated for their help and support. Furthermore, this STP would not have been possible without the attentiveness and countless hours volunteered by our peer reviewers to ensure that all of the manuscripts were suitable for publication. Finally, special thanks are given to the authors and reviewers of the papers for their outstanding efforts in writing and reviewing efforts that make the symposium and the STP possible. It is our sincere hope that these selected technical papers contribute significantly to the further advancement of the relevant topics.

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